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Background

Dental systems are under increasing pressure to contain costs whilst maintaining access to care. One solution is to adopt a team approach using skill-mix, where different personnel are employed with a spectrum of skills.¹⁻¹⁰ Some dental auxiliaries (DAs) are permitted to undertake a limited range of intra-oral clinical procedures. This group typically includes dental therapists, dental hygienists and clinical dental technicians, but nomenclature, training, permitted duties and regulation vary internationally.^{9,11}

Efficiency and access improvements might be influenced by the model of skill-mix adopted and the level of supervision required. Delegating aspects of care to DAs may liberate dentists' time to do more complex work, commensurate with their higher training. In addition, if workforce shortages exist, they could deliver services that would otherwise be unavailable. Where they substitute for dentists and are able to work independently, efficiency and access benefits are likely to be greater.^{8,9,12,13} Such potential benefits have encouraged direct access to DAs without the need for a dentist to prescribe care in some European countries and US states, New Zealand, and Australia.^{7,14-17}

However, skill-mix use is hotly debated.^{18,19} One concern is the impact it may have on the quality of care, particularly when it is to be extended and team members take on new roles.^{18,20} Quality in healthcare is a complex and multidimensional concept, with efficiency, effectiveness, access and lay acceptability of services being key factors.²¹⁻²³ The increasing importance of lay acceptability in quality assessment reflects wider social changes including patient-centred care, consumerism, and expansion of market principles.²³

The term acceptability has been used synonymously with patient satisfaction and measured using questionnaires, where service users evaluate care they have experienced. Yet, acceptability should be conceptualised more broadly. As well as an experiential element, acceptability should consider services' social acceptability and legitimacy; that is the extent to which they conform to social expectations, desires, norms, preferences and rules.²² A service's social acceptability and legitimacy would be particularly important where DAs' permitted duties are to be extended to new patients and supervision reduced.²⁴⁻²⁶

Our recent Cochrane review identified no high quality studies comparing the acceptability of care provided by DAs and dentists.⁹ The review excluded studies on social acceptability and legitimacy. Whilst Cochrane reviews assimilate the findings of research to yield robust answers to research questions, their inclusion criteria often exclude data from study designs undertaken in real world settings.²⁷ A wider review could provide important data on this topic. Therefore the aim of this study was to assess existing data on the acceptability of care provided by DAs.

Methods

Types of studies and participants

Studies of all designs were included. These included experimental and quasi-experimental studies, including randomised and non-randomised controlled trials (RCTs and NRCTs), controlled before and after studies (CBAs), interrupted time series (ITSs), observational studies (including case study research), descriptive studies (including ecological and cross-sectional studies) and qualitative research. Participants included patients or members of the public whose perspectives were sought on treatment provided by DAs. Such perspectives might be experiential (i.e. patients who had received treatment by DAs) or non-experiential.

The intervention and outcome measures

The intervention was the introduction of any type of DA to perform activities traditionally performed by dentists. In comparative studies, the comparator was dentists performing the same activities. These activities included: diagnosis and history taking, oral health education and promotion, scaling and polishing of teeth, preventive applications to teeth, simple fillings, root fillings, provision of pre-formed crowns and extractions of primary teeth in children. Studies were included that reported patients' or the public's perspectives of care, including social acceptability, social validity, patient satisfaction, experiential acceptability or any other patient-rated outcome measure as a primary outcome or secondary outcome.

Searches

Strategies for all databases were based on the Cochrane review⁹ strategy and translated appropriately for each, details of which are reported in the appendices of the full review.⁹ Neither language nor date limits were applied. The databases searched were: Cochrane EPOC Group's Specialised Register; Cochrane Oral Health Group's Specialised Register; Cochrane Central Register of Controlled Trials (CENTRAL); Cochrane Database of Systematic Reviews (CDSR); MEDLINE, Ovid; EMBASE, Ovid; Cumulative Index to Nursing and Allied Health Literature (CINAHL), EbscoHost; Database of Abstracts of Reviews of Effectiveness (DARE); PubMed; Dissertations and Theses, ProQuest; Latin American and Caribbean Health Sciences database (LILACS), Virtual Health Library (VHL); Pan American Health Organization database (PAHO), Virtual Health Library (VHL); World Health Organization Library Information System (WHOLIS); Web of Science; Health Management Information Consortium (HMIC), Ovid; NHS Economic Evaluations Database (NHS EED); Health Economics Electronic Database (HEED).

Two trials registries were searched (WHO International Clinical Trials Registry Platform Search Portal (ICTRP); and ClinicalTrials.gov) using a tailored strategy. Searches were undertaken from inception to 13 November 2013. A grey literature electronic search was also undertaken on websites concerned with the effective organisation of healthcare (Agency for Healthcare Research and Quality (AHRQ); National Institute for Health and Clinical Excellence (NICE); Pan American Health Organization (PAHO); World Bank; World Health Organization (WHO); Healthcare Information For All (HIFA) 2015; Open Grey) from inception to 10th July 2014.

Individual high yield journals were screened from January 2000 to December 2014 (*Community Dentistry and Oral Epidemiology*; *Community Dental Health*; *Journal of Public Health Dentistry*; *British Dental Journal*; *International Dental Journal*; *Journal of Dental*

Education). Conference proceedings were also screened and the reference lists of relevant systematic reviews, included studies and other relevant publications were reviewed.

Data collection and analysis

All identified citations and abstracts were downloaded into reference management software (EndNote®) and duplicates removed. The two researchers (TD and PGR) independently screened all titles and abstracts (where available), excluded studies that clearly did not meet the inclusion criteria and obtained full texts of potentially relevant references. The same researchers independently assessed the eligibility of retrieved papers. Disagreements were resolved by discussion.

As nomenclature, training, and permitted duties vary internationally, studies were allocated to three broad strata according to the predominant technique employed: studies in which DAs provided restorations; studies in which DAs scaled teeth; and studies in which DAs provided dentures.

Data extraction and management

Where possible, data were extracted from all studies that met the inclusion criteria and assessments of risk of bias undertaken. Although risk of bias assessments²⁸ and quality criteria²⁹ for studies included in Cochrane reviews exist (RCTs, NRCTs, ITs, and CBAs), they do not for other study designs. For such studies the level of evidence was reported using grades used by the Evidence-Based Dentistry Journal³⁰ and derived from the Centre of Evidence Based Medicine's study hierarchy (Table 1) and risk of bias and quality assessments were guided by existing checklists (Critical Appraisal Skills Programme (CASP)³¹ and STROBE.³² The methodological aspects considered were: sampling strategy, response rate, use of validated questionnaires, and appropriate hypothesis testing.

A global assessment of the quality of qualitative studies was guided by existing checklists^{31,33} and considered whether there was a clear description and rationale of: sampling; methods of data collection and analysis; triangulation of data; participant validation (or *member-checking*); and reflexivity. Studies were rated as strong, moderate or weak, depending on the extent to which these criteria were met.

Measures of treatment effect

A meta-analysis of the data had been planned *a priori*, but data quality did not support this. Given the range of study designs, measures of treatment effect are reported in different ways. Where possible, outcomes are reported in natural units. For qualitative studies, narrative summaries of outcomes are provided.

Table 1 here

Results

Electronic database searches identified 5869 non-duplicate citations (Figure 1) and a further 123 studies were identified from hand searching high yield journals (n=12), reference lists in

systematic and traditional reviews (n=102), reference lists of full text articles retrieved for eligibility assessment (n=8) and from experts in the field (n=1).

After screening titles and abstracts, full texts of 35 papers were obtained. Of these, six were excluded as they did not assess the public's or patients' perspectives on acceptability³⁴⁻³⁹ (Table 2), resulting in 29 studies included in the review (Table 3).

Twenty-five considered experiential acceptability and four considered social acceptability. None was experimental in design. Although detail provided varied, twenty-one involved DAs or student DAs restoring teeth, three scaling teeth, and five providing dentures. Although eight of the 29 studies were quasi-experimental for other outcomes, the element assessing acceptability was cross-sectional. One study used mixed-methods (a survey and a qualitative element), two were qualitative and in three the method was unclear. Most studies were evaluations of skill-mix or educational programmes. The results are stratified by the predominant procedure in each study and presented in narrative form and summarised at the end of each section with an indication of the level and quality of the evidence.

Figure 1 here

Table 2 here

Table 3 here

Experiential acceptability

Overview of studies

Twenty-five studies assessed patients' perspectives of care experiences. Although eight were quasi-experimental evaluations of skill-mix programmes, all used a cross-sectional design to assess acceptability. Nine compared the acceptability of care provided by DAs and dentists. Two comparative studies involved students.

Comparative studies

Auxiliaries providing restorations (n=3)

Sun and co-workers⁴¹ non-random case study compared satisfaction of patients treated by dentists and dental therapists in eight UK dental practices, using the validated Dental Visit Satisfaction Scale (DVSS). They reported higher satisfaction for dental therapists for overall satisfaction ($p<0.001$), and in the domains of information-communication, understanding-acceptance, and technical competence ($p>0.001$). However, they acknowledged risks of sampling bias (due to uncertain representativeness of participating practices) and response bias (due to differential response rates: dental therapists 54.2% v dentists 75.3%).

Lotzkar and co-workers compared satisfaction at two stages of a large US programme evaluation of the use of expanded function dental assistants and reported similar findings.^{42,43} Approximately 6400 patients were treated and questionnaires were administered after each visit. In both studies, the authors stated that 95% of care was evaluated as satisfactory and

equal to that of dentists. The content and validation of the questionnaire, response rates and hypothesis testing were not reported.

Auxiliaries scaling teeth (n=1)

Sisty and Henderson⁴⁴ surveyed 667 patients of dental students and 494 patients of student dental hygienists in the US, achieving response rates of 67% and 46% respectively. Although little detail was reported, student hygienists were rated higher for five out of six categories of “advanced” periodontal procedures, and higher in six categories for others. For other operative procedures, they rated similarly. Neither hypothesis testing nor validation of the questionnaire were reported.

Auxiliaries providing dentures (n=5)

Five studies compared satisfaction with dentures provided by DAs and dentists.⁴⁵⁻⁴⁹ A telephone survey of Canadian patients⁴⁵ reported no difference in satisfaction in most domains considered, but comfort and stability of lower dentures was lower in the technician group ($p<0.05$). Questionnaire validation and the response rate were not reported. In a US non-random survey, Friedrichsen and co-workers administered face-to-face interviews, which included a global question on satisfaction.⁴⁶ More patients treated by DAs reported being highly satisfied than those treated by dentists (68% v 52%) but no hypothesis testing was undertaken. Sampling and the response rate were not reported.

Two large Finish surveys assessed patient-rated outcomes and future intentions for treatment.^{47,48} In a survey of 2803 patients, no difference in satisfaction in dentures provided by DAs (94.1%) and dentists (95.4%) was identified with response rates similar in both groups (DAs 60.1% v dentists 61.9%). No hypothesis testing or validation of the questionnaire was reported.⁴⁷ The second study asked a random sample of 758 patients to rate quality of treatment.⁴⁸ From a 90.2% response rate, 56% would choose a DAs in the future compared with 33% choosing a dentist. The reasons reported were lower costs and the DA being at least as good as the dentist, although no numeric data were presented. Neither hypothesis testing nor validation of the questionnaire were reported.

The fifth study⁴⁹ evaluated four DA students and an unreported number of dental students providing removable prosthodontics in the US. Twelve patients of DAs and 18 of dental students completed a nine item questionnaire on satisfaction. In overall satisfaction and technical aspects (ability to chew and speak), DA students rated lower than dental students. However, they evaluated similarly for enjoyment of treatment and whether patients would recommend the clinician to others. Little detail of the method was provided. Neither hypothesis testing nor validation of the questionnaire were reported.

Summary of comparative studies

Existing data suggest that care from DAs can be at least as acceptable as that provided by dentists. All studies were cross-sectional and no higher than level 2C (Table 1) and assessed at high risk of bias. The highest quality study reported sampling and response bias concerns. Only two studies used hypothesis testing to compare outcomes for DAs and dentists.

Non-comparative studies

Auxiliaries providing restorations (n=13)

Similar findings were reported in two studies by the same research team evaluating an Australian educational programme using self-complete questionnaires.^{50,51} In the first, 115

patients treated by dental therapists trained to treat adults were surveyed and reported “strong satisfaction” immediately post treatment in their explanation and information provision, treatment received, helpfulness of dental therapists and their professional skills. After six months, of 80 patients (69.6% response rate), 90% would return to see a therapist for treatment, 85% would recommend them to other adults, but 2.5% would prefer a dentist for management of their gums or if it was a “big job”.⁵⁰ In a later study, patients were asked their level of agreement about therapists’ clinical experience and in a practicum.⁵¹ Mean scores were >4 (strongly agree = 5; strongly disagree = 1) for “care fixed my dental problem”, “dental health improved”, “received good care”, “things could not have been better”, “good advice on how to care for mouth”, “would recommend to others”, “would return to this dental therapist for treatment” and “overall satisfaction”. The authors reported that all patients of ten therapists reported high levels of satisfaction that compared favourably with the findings of a national dental survey. Few details of the methods were provided; the number of patients participating, response rates and validation of the questionnaires were not described.

Dyer and co-workers⁵² used a qualitative narrative method to assess experiences of patients and parents of children treated by dental therapists in six UK dental practices. Participants were overwhelming positive about care received, but reported the importance of trust in their supervising dentist and dental team and the continuity of care. They also highlighted the importance of trust in dentistry and the healthcare system to train and regulate dental therapists adequately for their use to be acceptable.

A large scale evaluation of Dental Health Aide Therapists (DHATs) used mixed-methods to assess the acceptability of them treating children in Alaska.⁵³ Using a validated questionnaire, the authors reported satisfaction of patients’ caregivers as “good” and comparable with other “types of providers”. Over 90% of all 233 participants responded that the DHATs always or usually “explained things”, “was easy to understand”, “listened carefully”, “treated the child with courtesy and respect” and “spent enough time with the child”. Although the authors reported undertaking qualitative interviews, which included questions on satisfaction, few details were provided in either the peer-reviewed published summary⁵³ or the main report.⁵⁴

Five North American programmes were evaluated using a time series design, however the acceptability element in each was cross-sectional.⁵⁵⁻⁵⁹ Mullins and co-workers⁵⁵ used a self-complete questionnaire with a purposive sample of patients from 14 different dental teams working in different practices using varying degrees of delegation. Few details of the method were provided. Neither the response rate nor numeric data were given but the authors reported no difference in satisfaction before or after delegation was introduced. In a large study involving 126 dental practices, Milgrom and co-workers⁵⁶ used a 13 item self-complete questionnaire. Few methodological details were provided; neither the response rate nor numeric data were reported. The authors stated there was no dissatisfaction with delegation. However, in practices with more delegation, there was lower satisfaction with dentist-patient relationships, waiting times, costs and continuity of care. Douglass and co-workers⁵⁷ evaluated expanded-duty dental assistants in a North Carolina private dental practice among 51 patients using a self-complete questionnaire. They reported “uniformly positive responses” regarding personal attention received, quality of care, and willingness to attend practices using such DAs. Very few other details of the method were provided. None of these three studies reported validating the questionnaire.

Two final time series evaluations of practices trialling DAs used dentists to provide anecdotal reports of patient satisfaction. Redig⁵⁸ reported patient satisfaction to be influenced by the confidence and enthusiasm of the supervising dentist in four practices and Romcke and Lewis⁵⁹ reported that only one patient refused further treatment with an extended function dental hygienist in six dental practices. Few details of the method were given, including the number of participants. No numeric data were reported in either study.

Three US studies appeared to use a cross-sectional design, although few details were provided.⁶⁰⁻⁶² Lobene⁶⁰ evaluated the Forsyth Experiment, which comprised models of delegation undertaken in a purpose built clinic in Boston. Evaluation was in two waves using a self-complete questionnaire, the content of which was not described. In wave one (2000 patients) the authors reported 2% were dissatisfied with treatment. In wave two (2668 patients), 94% were satisfied with treatment quality and operator competence, and 96% with comfort during treatment. The response rates were 100% and 45% for waves one and two respectively. Martens and co-workers⁶¹ used a postal self-complete questionnaire to assess satisfaction of 340 patients or heads of families treated by DAs as part of the TEAM clinic, which was part of the Minnesota School of Dentistry. Although few details were provided, they reported a response rate of 72% with the majority responding positively on the quality of care (99%), understanding nature of staff (94%), their willingness to recommend the clinic (84%), and whether they would be happy to return (90%). The *Philadelphia Program* employed DAs to deliver care from a clinic in Pennsylvania.⁶² Its evaluation used anecdotal comments from patients to assess satisfaction and reported “overwhelmingly positive acceptance by patients”. Few details of the method were provided.

The final study assessed the acceptability of US dental hygiene students trained to place restorations. All patients treated were invited to complete a validated online questionnaire containing four items on satisfaction.⁶³ Ninety-seven per cent or more of participants agreed that: they very satisfied/satisfied with their overall experience; the treatment was the same if not better than previous clinics; they would return for further work; and they would recommend the clinic to others.

Auxiliaries scaling teeth (n=3)

Chaffin and co-workers evaluated hygiene services in US military clinics using a validated self-complete questionnaire containing two items about satisfaction.⁶⁴ Of 130,801 patients treated over four years, 75.5% participated. Out of a maximum score of 7, mean satisfaction with an episode of care was rated as 6.6 and overall satisfaction was 6.4. Factor analysis revealed beliefs about care and interpersonal experience were best predictors of satisfaction.

Two large US studies evaluated independent hygiene practices. In both, all new patients were invited to complete the validated RAND questionnaire after their initial visit.^{65,66} In the first,⁶⁵ the authors reported responses from start-up (657 patients) and established practices (429 patients). In the former the response rate was 70.5%, with 99% strongly agreeing/agreeing that they were satisfied with care. In established practices the response rate was 49.9% and 98% strongly agreed/agreed they were satisfied. The second study⁶⁶ evaluated a demonstration project of dental hygiene care among 686 patients in nine unsupervised practices. Although the study compared ratings of care with general dental practice, the satisfaction element was non-comparative. Overall the response rate was 54.7%, with 98% reporting being satisfied with care, 89.3% disagreeing that things could have been

done better, 96% agreed the hygienist was careful to check everything when examining and 93% disagreed that the hygienist could have been more thorough.

Summary of non-comparatives studies

Existing data suggest high levels of acceptability of care provided by different types of DAs. The quantitative studies were cross-sectional in design (level 2C)(30)³⁰ were assessed at high risk of bias. Only three used a validated questionnaire. All had sampling bias concerns. Those reporting response rates were at risk of response bias. The purely qualitative study was assessed as “strong”.

Social acceptability

Auxiliaries providing restorations (n=4)

Four studies considered the social acceptability of care that might be provided by DAs with permitted duties akin to that of a dental therapist,^{24,25,67,68} i.e. participants had not experienced treatment by them. Two telephone surveys of representative quota samples of South Yorkshire, England (n=500)⁶⁷ and the UK (n=1000)²⁴ reported similar findings.

Approximately two thirds of people were willing to receive restorative treatment from dental therapists (64.0% and 68.5% respectively) and about half were willing for children to receive the same treatment (47.0% and 54.7% respectively). In the UK study,²⁴ approximately one fifth (20.4%) would not be willing to receive any treatment from a therapist. Logistic regression identified common predictors of social acceptability as being younger and having need for treatment. Those receiving some private care (i.e. non-NHS subsidised) were less likely to regard therapists as acceptable ($p < 0.05$).^{24,67}

Gilmore's⁶⁸ postal survey of a random sample of the Massachusetts population (n=1200) inquired about views on the acceptability of extending hygienists' skills to that similar to a dental therapist. Few other details of the method were provided and the response rate was only 5%. The authors reported that attitudes towards extending skills were “generally positive” but no numeric data were provided.

Using semi-structured interviews and focus groups with a purposive sample of the public (n=27), Dyer and Robinson²⁵ reported views on dental therapists providing care for adults and children. Social acceptability was influenced by factors including: familiarity and trust in their dentist and dentistry; perceptions of competence of therapists and attitude of the dentist; and perceived potential benefits of using DAs (shorter waiting times, better access, reduced costs). Higher social acceptability of DAs was related to seeing dentistry as a collectivist service for public good rather than as an individualised, private service.

Summary of social acceptability studies

The three surveys reported varying social acceptability of DAs with permitted duties of a contemporary dental therapist (level 2C).³⁰ Two reported lower social acceptability of them treating children than adults, and one reported that one fifth would be unwilling to receive any treatment from them. Both telephone surveys carried sampling and response bias risks, but other aspects of the method and analyses were strong. The postal survey held very high risks of many forms of bias. The qualitative study was assessed as strong.

Discussion

This systematic review identified 29 studies that were eligible for inclusion. Overall, patients reported high acceptability of care provided by DAs, including restoring and scaling teeth and the provision of dentures, and in comparative studies it was at least as high as that provided by dentists. Most people felt treatment by DAs with permitted duties of a contemporary dental therapist to be socially acceptable, though care for children was seen as less acceptable than for adults, with some unwilling to receive any treatment from them. Although a small number of the quantitative studies were methodologically robust, most were at high risk of a range of biases and overall the evidence must be regarded as of low quality. However, the purely qualitative studies were strong.

The lack of high quality data reported here is consistent with the findings of previous systematic⁶⁹⁻⁷² and traditional⁸ reviews of acceptability or patient satisfaction with DAs. These reviews also had broad inclusion criteria. Freeman and co-workers⁷⁰ could not identify any studies that sought patients' views of the acceptability of care provided by dental therapists in rural or remote settings. From an experiential perspective, the other reviews' conclusions were similar to these; DAs' patients are at least as satisfied as those of dentists across a range of clinical tasks but the quality of the evidence is low.^{8,69,72}

The importance of lay perspectives on the quality of health services, particularly its acceptability, is increasing,^{23,73,74} especially where there are plans to extend the use of skill-mix.⁷⁵⁻⁷⁷ Given the recent enhancement and innovation of the remit of DAs in certain countries, including the introduction of direct access,^{26,78,79} it is surprising that high quality data do not exist to inform these policy decisions. Moreover, a paradox exists where quality frameworks assert the primacy of public and patient perspectives, yet policy decisions about the reorganisation and delivery of care have been made in the absence of high quality evidence of the acceptability of using DAs.

Many studies (Table 3) were undertaken in North America, are more than 15 years old and formed part of evaluations of skill-mix "experiments" delivered from specially designed clinical facilities, rather than typical dental practices or clinics. Often little detail was provided on the DAs' training and their permitted duties. Only nine directly compared the views of patients treated by DAs and dentists, eight of which reported satisfaction with care as the same or higher than that provided by dentists. However, the design of these studies and their methodological frailties mean that limited conclusions can be drawn from them. Perhaps most importantly, there is a risk of selection bias where patients had volunteered to be treated by DAs and were therefore accepting of the notion of being treated by them at the outset. Given the varying levels of social acceptability of dental therapists reported in UK studies^{24,25,67} (approximately a fifth of the public were unwilling to receive any treatment from dental therapists),²⁴ future evaluations should use representative samples to minimise selection bias risks. Nevertheless, these studies indicate large proportions of the population would be willing to accept treatment from them.

Given the quality of studies identified and that none could be included in a Cochrane review,⁹ better designed and executed studies across a range of settings and contexts are needed. Although there have been recent policy and regulatory changes in some countries to facilitate the use of DAs,^{26,71,79} high quality evidence is required to inform policy-makers and the dental profession of their legitimacy.^{20,80} In addition, the dental profession, notably in the US and Canada, hotly debates DAs enhancing and innovating their skills and remit.^{8,12,18,19,81,82} High

quality evidence of the acceptability to patients and the public of the use of DAs would illuminate these debates.

It would seem RCTs could be undertaken for most interventions that DAs undertake. However, where dental services are reorganised to increase the use skill-mix and an experimental design is impractical, other robust non-randomised designs (such as ITSs and CBAs) could be used, incorporating assessments of experiential acceptability. Although this has been traditionally undertaken quantitatively, theoretical and methodological problems with patient satisfaction including the value of solely assessing acceptability using quantitative measures has been questioned, thus mixed-method approaches have been recommended.⁸³⁻⁹⁰ Other robust methods have been used to evaluate the reorganisation of services using skill-mix including case study research^{41,91} as part of realist evaluation. Such methods investigate complex organisational factors empirically while considering contextual influences and triangulate data from various sources.^{92,93} Future systematic reviews of the acceptability of DAs should include other quantitative and qualitative studies, yet maintain methodological rigour in other aspects of design, including the assessment of risk of bias and quality of the evidence. As qualitative approaches are increasingly used to provide more holistic assessment of processes and outcomes, methods exist to identify, appraise and synthesise qualitative and quantitative data from studies of diverse designs. However, these are methodologically challenging and some Cochrane review groups are yet to permit them.^{29,94-96}

As in any research, these findings should be interpreted with care. All identified sources in this review were independently sifted by two researchers. Although the search strategy was developed with an experienced information technologist, and reviewed by another, some relevant studies did not have abstracts or did not include a term for a DA in the title. Consequently, high yield journals and reference lists of included studies, systematic⁶⁹ and traditional reviews⁸ were hand-searched. In addition the reference lists of recently published systematic reviews were also searched.^{70-72,97} Nonetheless, it is possible that relevant studies have been missed.

The findings of this review are presented in broad strata of the predominant technique provided by the DA in each study. As nomenclature, training and permitted duties vary internationally and have changed over time, the DAs involved in each stratum are not homogenous, and the validity of pooling data might be questioned. For example, data extracted from recent studies involving dental therapists might relate to the extraction of deciduous teeth as well as providing restorations. Given that little detail was provided in many of the older studies, the extent of heterogeneity in each stratum is unknown. Despite these concerns, the studies' findings were consistent, regardless of the age of the study, the country of origin or the type of DA involved.

There is also a risk of publication bias in systematic reviews, where studies reporting that patients treated by DAs were more or less satisfied than those treated by dentists are less likely to be published. As the quality of the data does not support assessment of publication bias, its risk is unknown.

There are well-established approaches to risk of bias and quality assessment of RCTs and quasi-experimental studies^{27,28} but not for other quantitative studies. This systematic review used critical appraisal checklists to assess bias and quality.^{31,32} While other systematic reviews with broad inclusion criteria used similar approaches,^{70,71} Wright and co-workers used a score rating modified from that of Downs and Black.⁹⁸ Applying their rating scale to these data would have also identified risk of bias as high and quality low. Although assessing

methodological quality of qualitative studies using checklists and composite scales is controversial,^{99,100} the criteria used in this systematic review are consistent with existing checklists^{31,33} and those used in other systematic reviews.^{70,101}

Conclusion

Although data on the acceptability of different types of DAs delivering a range of dental care exist, they are of low quality. Overall, those that have experienced treatment are satisfied with the treatment received, and in comparative studies, they report it as at least as acceptable as that provided by dentists. Public views on the social acceptability of treatment undertaken by DAs with the permitted duties of a contemporary dental therapist vary; most adults would accept treatment from a DA but care for children was seen as less acceptable. More high quality, methodologically rigorous studies are required which should minimise selection and response bias risks.

Conflicts of interest

TD has taught on the Diploma in Dental Hygiene and Therapy at the University of Sheffield, UK.

PGR was the Course Director and teaches on the Diploma in Dental Hygiene and Therapy at the University of Sheffield, UK.

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